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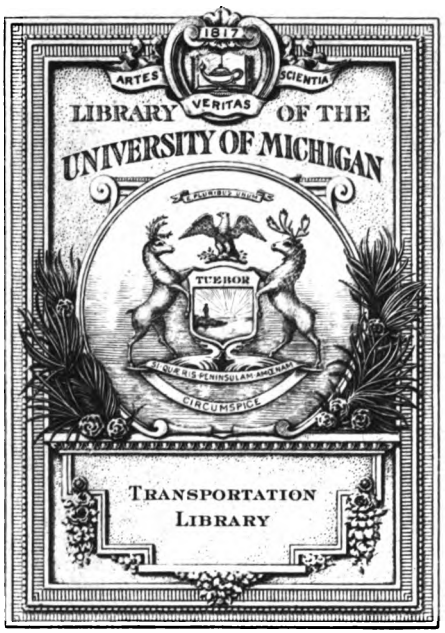

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UNIVERSITY BULLETIN

NEW SERIES, VOL. XXI, NO. 18 DECEMBER 20, 1919

UNIVERSITY OF MICHIGAN.

COLLEGES OF ENGINEERING AND ARCHITECTURE.
DEPARTMENT OF CIVIL ENGINEERING.

SPECIAL ANNOUNCEMENT OF COURSES IN

HIGHWAY ENGINEERING
AND
HIGHWAY TRANSPORT

1919-1920

ANN ARBOR
PUBLISHED BY THE UNIVERSITY
1919

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INTRODUCTION

The Board of Regents of the University of Michigan, by its action on August 6, 1919, in establishing a Chair of Highway Engineering in the Department of Civil Engineering and also its authorization of the appointment of an Assistant Professor and assistants in Highway Engineering, has made provision for a broad development of highway engineering and highway transport undergraduate and graduate instruction, and for the investigation of the many problems which have developed on account of the rapid changes in conditions in recent years.

Thoroughly trained and experienced highway engineers are needed to occupy the innumerable positions connected with the administration, financing, design, construction and maintenance of the 2,500,000 miles of rural highways and the thousands of miles of streets in the municipalities of the United States in order that the highways of our country may efficiently serve the agricultural, industrial, commercial, social and military requirements of the Nation. Highway appropriations will increase rapidly during the next five years as is indicated by the 1919 appropriations of approximately $500,000,000 for highway improvements and a widespread demand for the construction of a system of 50,000 miles of National Highways by the Federal Government under the direction of a National Highway Commission. Highway officials, progressive educators and many prominent business men realize that a serious condition will confront the United States if graduates of our technical schools are not properly trained in highway engineering.

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The phenomenal development of highway transportation in the United States has created a demand for men having knowledge of and trained in a new technical field, which may be designated Highway Transport Engineering. Fundamentally, this branch of engineering deals with the science, art, economics and business of highway transportation of passengers and commodities. During the past decade, the United States has witnessed a rapid growth in the utilization of the motor vehicle as indicated by a registration of 125,000 motor vehicles in 1908 and 6,146,617 in 1918. While in 1908, a motor truck was rarely seen on American highways, in 1918 not less than 600,000 were in use in the United States, motor trucks constituting from ten to twenty percent of the registered motor vehicles in the several States.

The University of Michigan will offer unlimited facilities for instruction and research work in Highway Engineering and Highway Transport. The Engineering Catalogue for 1919-1920 having been issued before the authorization of the enlarged program in highway engineering, this supplementary announcement is issued to give information as to new courses that will be offered.

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FACULTY CHANGES

On August 6th the Regents appointed as Professor of Highway Engineering, Professor Arthur H. Blanchard, A.M., C.E. Professor Blanchard was graduated from Brown University in 1899, and received the degree of A.M. from Columbia in 1902. From October 1909 to September 1910 and the summer of 1913 he spent in Europe studying highway transport, and the financing, construction, maintenance and operation of roads and pavements in Great Britain and on the continent. His teaching experience of eleven years at Brown University and six years as Professor of Highway Engineering at Columbia; his wide professional experience, including such engagements as those of consulting engineer for the United States office of Public Roads, the State Highway Commissions of New York and Pennsylvania, and the Board of Water Supply of the City of New York; his recognized standing as an author on the subject of highway engineering and as Editor-in-Chief of the American Highway Engineers' Handbook; and his wide acquaintance due to his activity in all of the leading engineering and highway societies, all tend to eminently qualify him for such a position.

Professor Blanchard is at the present time President of both the American Road Builders' Association and the National Highway Traffic Association and holds important committee assignments in the American Society for Municipal Improvement, American Society for Testing Materials and Association Internationale pour l'Essai des Materiaux.

Mr. John H. Bateman, B.C.E., has been appointed to the Assistant Professorship, and as Director of the Lab-

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oratory. Mr. Bateman has for four years been Engineer for the Michigan State Highway Commissioner and has intimate knowledge of the problems and local conditions in the State of Michigan. Along with his university duties Professor Bateman will have the general direction of the testing of materials for the State Highway department, the Cities, Counties and Townships of the State, and will direct the university work on the State Survey of Road Materials.

FELLOWSHIPS

The Detroit Edison Fellowship in Highway Engineering.—The Detroit Edison Company announces, under date of August 16, 1919, the renewal of a fellowship suspended during the war. This fellowship pays the holder $500 per year with an allowance of $100 for expenses. It will be continued for the years 1919-1920 and 1920-1921. The investigation will be the subject of Moderate Cost Country Roads.

The R. D. Chapin Fellowship in Highway Engineering.—On August 29th, Mr. R. D. Chapin of Detroit, President of the Hudson Motor Car Company, renewed the fellowship given by him prior to the War. This fellowship is offered to provide for the study of hard surface roads and pavements. It pays the sum of $500 to the holder, with an allowance of $100 for expenses. It is available for the year 1919-1920.

General.—Appointments of 1919-1920 Fellows have not been made. All candidates applying up to October 10th will be considered. A Fellow must have a Bachelor's degree in Civil Engineering from a college of recognized standing. He must enroll as a candidate for the degree of Master of Science in Engineering and be in residence at the University for eight months.

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HIGHWAY LABORATORY

The Highway Laboratory at present occupies the north half of the old campus power house, which gives a reasonable amount of room for present needs. The laboratory is well equipped for the testing of stone, gravel, brick, cement and bituminous materials. The Regents have made quite large appropriations for additional equipment which will be installed this winter. It is probably not too much to say that, with the new equipment in place, it will be one of the best laboratories of the kind in the United States.

FREE TESTING OF ROAD AND PAVING MATERIALS

It is the wish of the Regents and of the College of Engineering to make the Highway Laboratory of the greatest possible usefulness in the development of the State's highways and the improvement of its cities. In pursuance of this purpose plans were perfected about a year ago for the testing of road-making and paving materials intended for public uses in the State, without any charge other than for the expense of shipping samples.

Under this arrangement the Highway Laboratory has made a large number of tests upon samples of materials received from practically every part of the State, and has reported the results of these tests back to the city, county or township officials by whom the samples were submitted. In addition, the Laboratory has made some tests for the State Highway Department, for which it has also undertaken certain special investigations.

The Laboratory is prepared to make all the standard tests upon practically every kind of material commonly used in the building of country roads and city pavements, including cement and other materials used in concrete. City engineers or county, township or other highway

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officials, when desiring to submit samples, should write to John H. Bateman, Highway Laboratory, University of Michigan, to obtain suitably addressed tagged envelopes containing instructions for the collection and shipment of samples. An important requirement is that the instruction sheet must be completely filled out with the information asked for, as the University is making an effort to collect and compile data regarding the extent, character and use of Michigan's road-building materials.

LIBRARIES

The Davis Library of Highway Engineering, located in Room 407 of the Engineering Building, is the most complete collection of works on highway engineering and allied subjects in this country. All the most recent books in English, French and German have been purchased and in addition many old volumes which are of interest from a historic point of view have been secured. Town, municipal, county, park, state and government reports and specifications, many monographs and complete files of trade publications also form an important part of this Library. All technical periodicals which contain articles relative to highway engineering and allied subjects are on file, hence the latest literature on the science and art of highway engineering is available.

In addition to the Davis Library, the University Library and the Engineering and Chemical Libraries may be used by advanced or graduate students in highway engineering.

UNDERGRADUATE AND ADVANCED COURSES

Civil Engineering 7a. Concrete and Steel Highway Bridge Design. Three hours. Second semester only.

A drawing room course in the design of reinforced concrete and structural steel. This is a modification of

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Course 7 specially designed to meet the requirements of students electing the Highway Engineering Group. Course 7a must be preceded by Course 3.

Open to fourth-year, fifth-year and graduate students.

Civil Engineering 36. Municipal Engineering. Two hours. Second semester only.

Lectures and library reading.

This course covers the subjects of organization, methods and cost of street cleaning; collection and disposal of garbage and other city wastes; and certain other administrative problems with which the city engineering office has to deal.

Open to fourth-year, fifth-year and graduate students.

Civil Engineering 40. Highway Engineering. Two hours. Both semesters.

Lectures and recitations, with assigned reading.

The course will treat of the fundamentals of highway engineering, including a study of the historical development of highways and highway transport; economics, administration and legislation; preliminary investigations and transportation surveys; surveying and mapping peculiar to highway engineering; essential factors in the economic design of highways, including location, drainage, foundations, widths, curves, grades, and selection of type of surfacing; essential features of the construction and maintenance of the different types of roads and pavements and the materials used therein; street cleaning and snow removal; and highway structures.

Required of all Civil Engineering students.

Civil Engineering 41. Highway Engineering Economics and Theory. Two hours. Second semester only.

Lectures and recitations, with assigned reading and problems, supplemented by inspection trips.

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This course includes a detail study of preliminary investigations, highway transport surveys and the theory of highway design. Preliminary investigations and theory of design will include consideration of the following subjects: Highway systems, locations, foundations, drainage, widths, cross-sections, intersections, curves, grades, local materials, climatic conditions and selection of type of wearing course. Under traffic, will be considered the following topics: Traffic classification; traffic census; external forces, internal stresses and strains due to different classes of traffic on wearing courses and foundations; and weights, speeds and dimensions of vehicles. Highway transport surveys will include investigations of highway routes, highway transport legislation, traffic regulations, rural and urban transportation opportunities, and competing carriers including railway and waterway transport facilities.

Course 41 must be preceded or accompanied by Course 40.

Open to fourth-year, fifth-year and graduate students.

Civil Engineering 42. Highway Engineering Laboratory. Two hours. Both semesters.

Lectures, assigned reading and laboratory work.

This course includes the testing of cements and aggregates used in cement-concrete construction, the testing of broken stone and slag for hardness, toughness, abrasion, cementation, absorption and specific gravity; tests of the physical properties of sand and clay mixtures, sand, gravel, brick, wood blocks and stone blocks. Special emphasis is laid upon proper methods of making, reporting and interpreting tests of construction materials.

Course 42 must be preceded or accompanied by Course 40.

Open to fourth-year, fifth-year and graduate students.

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Civil Engineering 43. Highway Engineering Design. Three hours. Second semester only.

Lectures and recitations, with assigned reading and design problems, supplemented by inspection trips.

This course covers the design of highways and highway systems, drainage systems, culverts and small highway bridges, foundations, curves, grades, right-of-way and street intersections, widths of right-of-way and roadways, and cross-sections, and discussions of field methods of reconnoisance and surveying, and office methods used in mapping, estimating and recording.

This course must be preceded or accompanied by Course 41.

Open to fourth-year, fifth-year and graduate students.

Chemical Engineering 19. Bituminous Paving Materials. One hour. First semester.

Lectures, assigned reading and laboratory work.

This course will include a consideration of the following subjects: Classifications of bitumens; petroleum and petroleum products; semi-solid and solid native bitumens; tar and tar products; manufacture of road oils and oil asphalts; refining of native asphalts and manufacture of asphalt cements; manufacture of coal gas and water-gas tar dust preventatives and road binders; demonstrations of methods of examination and analysis including extraction, evaporation, distillation, filtration, and determination of specific gravity, melting point, flow point, viscosity, float test, penetration, ductility, solubility, flash and burning points, fixed carbon and paraffin.

This course must be preceded or accompanied by Course 5 in Chemical Engineering or Course 40 in Civil Engineering.

Open to fourth-year and fifth-year students.

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GRADUATE SHORT PERIOD COURSES

Graduate work in highway engineering, highway transport and allied subjects leading to the degree of Master of Science in Engineering will be arranged especially for men engaged in the practice of highway engineering and highway transport. These courses will be given only during the months from December to March inclusive. This plan will afford highway engineers, chemists, contractors, engineer-salesmen, highway transport managers, motor truck salesmen and others interested in highway engineering and highway transport an opportunity to obtain advanced knowledge during the season of the year when a leave of absence may be easily obtained. This plan has the support of many of the foremost highway officials and engineers, and highway transport experts in the United States. During 1919-1920, the four courses, described in this Announcement, will be offered. During 1920-1921, sufficient short period graduate courses in highway engineering, highway transport and related subjects will be offered to cover the required amount of graduate work for the degree of Master of Science in Engineering. Persons of mature age, who do not hold collegiate or technical degrees, but who give evidence of fulfilling the prerequisites of a given course may register as special students, not candidates for a degree. For further information pertaining to the short period graduate courses, write to Arthur H. Blanchard, Professor of Highway Engineering, University of Michigan, Ann Arbor, Mich.

Civil Engineering 67. Highway Transport.

Lectures, discussions, assigned reading and field investigations.

This course will include a consideration of the following subjects: History of American transportation

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and rural development; English highway transport methods and legislation; interrelationship of highway, railway and waterway transportation including influencing factors of distances, rates, kinds of freight and equipment; port, terminal and warehouse facilities; interrelationship of highway transport, good roads and rural development; American highway traffic legislation including national, state, county, township and municipal laws, licenses, taxes and traffic regulations; fundamentals of highway engineering affecting economic highway transport; American highway transport methods; transportation surveys.

Open only to graduate students and qualified special students.

Civil Engineering 68. Bituminous Surfaces and Bituminous Pavements.

Lectures, discussions, assigned reading and inspection trips.

This course will cover bituminous surfaces, bituminous macadam pavements, bituminous concrete pavements, asphalt block pavements and sheet asphalt pavements. Each type of construction will be considered from the following standpoints: Description and historical development; economic value, conditions under which it may be used, and foundations; theory and design, external forces, internal stresses and strains; kinds of bituminous and non-bituminous materials used and desirable qualities thereof; methods of construction; types of machinery used, important features and manipulation thereof; inspection methods; nature of wear and deterioration, and causes of premature failures; methods of maintenance; guarantees, essential features and economics.

Open only to graduate students and qualified special students.

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Civil Engineering 69. Highway Laboratory Research.

Lectures, discussions, assigned reading, laboratory and field investigations.

This course will include advanced problems pertaining to the physical properties of earth, sand and clay mixtures, sand, gravel, broken stone, broken slag, paving brick, cement-concrete, wood blocks and stone blocks; highway laboratory administration, organization and equipment; sampling and inspection methods; reports and records; field surveys and investigations.

Open only to graduate students and qualified special students.

Civil Engineering 70. Highway Bridges.

Lectures, discussions, assigned reading, and problems, drawing room design and field inspections.

Advanced course in the study of the economics, theory, design and maintenance of all types of highway bridges including preliminary investigations; determination of waterways; standard types of highway bridges of wood, steel, cement-concrete and reinforced concrete; highway bridge foundations and floors; various classes of loads.

Course 70 must be preceded by Course 6.

Open only to graduate students and qualified special students.

ANNUAL SHORT COURSE IN HIGHWAY ENGINEERING

The purpose of this short course is to aid in supplying information to highway commissioners and engineers relating to the construction and maintenance of country roads. The course will be given from the viewpoint of Michigan conditions, materials and laws. Practical instruction will be given relative to the latest practice in

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the construction and maintenance of roads and bridges. The course will be held at a time when both commissioners and engineers may attend. Lectures will be given by highway engineers who are specialists in their line. The list will include, in addition to special lecturers from other States, engineers from the Michigan State Highway Department and members of the Faculty of the University of Michigan. The course will be open to all highway commissioners, engineers, contractors, and others interested in road construction and maintenance. No fees will be charged by the University. Further Special Announcement of the dates and program will be issued in November or December 1919.

HIGHWAY TRANSPORT CONFERENCE

During the collegiate year of 1919-1920 there will be held at the University of Michigan a Highway Transport Conference consisting of morning and afternoon sessions for a period of one week. The following subjects will be presented by experts: Speeds, weights and dimensions of motor trucks, tractors, trailers and motor-busses; legislation relative to highway transport franchises; interrelationship between highway, railway and waterway transport; port, terminal and warehouse facilities including efficient methods of packing, handling, loading and unloading raw and manufactured materials; "Back to the Farm" movement, a function of three fundamentals, namely, building of systems of good roads, utilization of highway transport, and establishment of economic distribution from producer to consumer; inter-city haulage; long and short haulage outside of cities; rural motor express; return loads bureaus; plant and factory haulage; highway transport management; fundamentals of cost of highway transport; cost and record systems; transportation surveys; fundamentals of highway engineering af-

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fecting economic highway transport including traction, grades, foundations, curves, widths of roadway, shoulders, types of roads and pavements, bridges, detours and highway signs. The Conference will be open to all interested in highway transport. No fees will be charged by the University. Details of the program of the Conference will be given in a special announcement to be issued in November or December 1919.

GENERAL INFORMATION

Men intending to enter the University may secure a copy of the catalogue of the Colleges of Engineering and Architecture containng full information as to all work given, fees, expenses, and other information, by making application to LOUIS A. HOPKINS, Secretary, College of Engineering, Ann Arbor, Mich.

THE UNIVERSITY BULLETIN IS REGULARLY ISSUED BY THE UNIVERSITY OF MICHIGAN ON THE 1ST, 10TH AND 20TH OF EACH MONTH.

ENTERED AS SECOND-CLASS MATTER AT THE POSTOFFICE AT ANN ARBOR, MICHIGAN.

THE BULLETIN INCLUDES THE FOLLOWING PUBLICATIONS:—

The Annual Report of the President.

The Catalogue of the University.

The Annual Announcements of the College of Literature, Science, and the Arts, the Colleges of Engineering and Architecture, the Medical School, the Law School, the College of Pharmacy, the Homœopathic Medical School, the College of Dental Surgery, the Graduate School, and the Summer Session.

Other Announcements of the several departments of instruction, Reports and Communications of University officers, etc.

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UNIVERSITY OF MICHIGAN

Supplement to Bulletin No. 18, Vol. XXI, New Series

Highway Engineering and Highway Transport

PERIODS AND FEES FOR GRADUATE COURSES DECEMBER 1, 1919 TO MARCH 19, 1920

Civil Engineering 67. Highway Transport. Professor Blanchard. February 2nd to 6th, Monday to Friday, 1:30 to 4:30 P. M. 1 hour credit.

Civil Engineering 68. Bituminous Surfaces and Bituminous Pavements. Professor Blanchard. December 1st to 19th, Mondays to Fridays, 1:30 to 4:30 P. M. 3 hours credit.

Civil Engineering 69. Highway Laboratory Research. Professor Bateman. January 5th to 23rd, Mondays to Fridays, 10 A. M. to 12 M. and 1:00 to 5:00 P. M. 2 to 3 hours credit, dependent upon a student's previous training in highway laboratory methods.

Civil Engineering 70. Highway Bridges. Professor Gram. February 9th to 20th, Mondays to Fridays, 1:30 to 4:30 P. M. 2 hours credit.

Civil Engineering 71. Specifications and Contracts. Professor Riggs. February 9th to 20th, Mondays to Fridays, 1:30 to 4:30 P. M. 2 hours credit.

Civil Engineering 72. Earth, Gravel and Broken Stone Roads. Professor Bateman. March 1st to 12th, Mondays to Fridays, 1:30 to 4:30 P. M. 2 hours credit.

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Civil Engineering 73. Cement-Concrete Pavements. Professor Blanchard. March 1st to 9th, Mondays to Fridays, 1:30 to 4:00 P. M. 1 hour credit.

Civil Engineering 74. Brick Pavements. Professor Blanchard. March 11th to 19th, Mondays to Fridays, 1:30 to 4:00 P. M. 1 hour credit.

Civil Engineering 75. Highway Engineering Seminar. Professor Blanchard. December 1st to March 19th. 3 hours credit.

Fees: The fees for courses are based on the number of credit hours for each course. The fee for each credit hour is five dollars.

Annual Short Course in Highway Engineering. February 23rd to 27th. Morning and afternoon sessions. No Fees. Open to the public.

Highway Transport Conference. As the National Automobile Chamber of Commerce will hold a Highway Transport Conference in New York City, January 3rd to 10th, and one in Chicago, January 24th to 31st, the University of Michigan will not hold a Conference this year.

For further information pertaining to the short period graduate courses, write to Arthur H. Blanchard, Professor of Highway Engineering, University of Michigan, Ann Arbor, Mich.

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UNIVERSITY BULLETIN

NEW SERIES, VOL. XXII, NO. 5 JULY 31, 1920

UNIVERSITY OF MICHIGAN

COLLEGES OF ENGINEERING AND ARCHITECTURE
DEPARTMENT OF CIVIL ENGINEERING

Graduate Short Period Courses
in
Highway Engineering
and
Highway Transport
1920-1921

ANN ARBOR
PUBLISHED BY THE UNIVERSITY
1920

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INTRODUCTION

The Board of Regents of the University of Michigan, by its action in establishing a Chair of Highway Engineering and Highway Transport in the Department of Civil Engineering and also its appointment of an Assistant Professor and assistants in Highway Engineering, has made provision for a broad development of highway engineering and highway transport undergraduate and graduate instruction, and for the investigation of the many problems which have developed on account of the rapid changes in conditions in recent years.

Thoroughly trained and experienced highway engineers are needed to occupy the innumerable positions connected with the administration, financing, design, construction and maintenance of the 2,500,000 miles of rural highways and the thousands of miles of streets in the municipalities of the United States in order that the highways of our country may efficiently serve the agricultural, industrial, commercial, social and military requirements of the Nation. Highway appropriations will increase rapidly during the next five years as is indicated by the 1920 appropriations of approximately one billion dollars for highway improvements.

The phenomenal development of highway transportation in the United States has created a demand for men having knowledge of and trained in a new technical field, which may be designated Highway Transport Engineering. Fundamentally, this branch of engineering deals with the science, art, economics and business of highway transportation of passengers and commodities. During the past decade, the United States has witnessed a rapid growth in the utilization of the motor vehicle as indicated by a registration of 125,000 motor vehicles in 1908 and

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7,558,848 in 1919. While in 1909, a motor truck was rarely seen on American highways, in 1919 not less than 750,000 were in use in the United States, motor trucks constituting from ten to twenty percent of the registered motor vehicles in the several States.

The demand for men trained in highway engineering and highway transport was crystalized at the Washington Conference on Highway Engineering and Highway Transport Education held in May, 1920, at the call of Dr. P. P. Claxton, U. S. Commissioner of Education. The seventy delegates representing the automotive and tire industries, transportation organizations, the state highway departments, the U. S. Bureau of Public Roads, the War Department, and colleges of engineering unanimously adopted the following conclusions: First, the highway engineering staffs of the Federal and State Departments will require an annual supply of 900 college trained engineers in addition to the highway engineers required by counties, municipalities, contractors and companies manufacturing highway machinery and materials; second, that 4,000 men should be trained in highway transport each year in universities for positions of motor truck fleet managers, sales-engineers, advertisers, business administrators and highway transport engineers; and third, that short period advanced courses efficiently provide opportunities for men occupying the positions enumerated to obtain a knowledge of and training in highway transport.

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GRADUATE SHORT PERIOD COURSES

General Statement

Graduate work in highway engineering and highway transport, leading to the degree of Master of Science or Master of Science in Engineering, has been arranged especially for men engaged in the practice of highway engineering and highway transport. These courses will be given *in periods of two weeks each* during the months from December to March, inclusive. Each course will consist of thirty lectures, or the equivalent thereof, and will count as two hours credit towards the total of twenty-four hours required for the Master's degree. The University also requires that each candidate for a Master's degree shall be in residence for one collegiate year or eight months. Candidates for the Master's degree, who are taking graduate courses in highway engineering or highway transport, may fulfill the residence requirement in one of three ways: First, by being in residence for one collegiate year or from October to June; second, by being in residence for two winter periods from December to March, inclusive; and third, by the distribution of residence over several years by being in attendance for parts of three or more winter periods. The University further requires that each candidate for a higher degree must hold a baccalureate or engineering degree from an approved institution. Persons of mature age, who do not hold collegiate or technical degrees, but who give evidence of fulfilling the pre-requisites of a given course may register as special students, not candidates for a degree.

The above plan, which has the support of many of

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way transport experts in the United States, will afford highway engineers, chemists, contractors, engineer-salesmen, highway transport engineers and managers, motor truck salesmen and others interested in highway engineering and highway transport an opportunity to obtain advanced knowledge during the season of the year when a leave of absence may be easily obtained.

For further information pertaining to undergraduate and graduate courses in highway engineering and highway transport, write to Arthur H. Blanchard, Professor of Highway Engineering and Highway Transport, University of Michigan, Ann Arbor, Mich.

ADMISSION AND REGISTRATION

Every student who expects to be an applicant for admission to the Graduate School as a candidate for the degre of Master of Science or Master of Science in Engineeering, should obtain a copy of the Announcement of the Graduate School, which gives full information concerning the conditions under which the Masters' degrees are conferred. Requests for Announcements should be addressed to Dr. Alfred H. Lloyd, Dean of the Graduate School.

All students who wish to enroll in the Graduate Short Period Courses, should report, upon arrival at the University, at the office of the Professor of Highway Engineering and Highway Transport, Room 409, Engineering Building. After the schedule of courses has been arranged, a student, who has received a baccalaureate or professional degree, will register at the office of the Graduate School in University Hall, while a student, who does not hold a degree, will register in Room 407, Engineering Building, as a special student in the Colleges of Engineering and Architecture.

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FEES AND EXPENSES

Graduate Short Period Courses. The fee for each of the graduate short period courses in highway engineering and highway transport, Civil Engineering 67 to 84, and Mechanical Engineering 40, is ten dollars. Students in residence only during the winter period, December to March, and who are taking only the graduate short period courses do not have to pay a matriculation fee.

Semester Courses in the Graduate School. Matriculation fee, for Michigan students, ten dollars; for all others, twenty-five dollars. Annual fee, for Michigan students, eighty-two dollars; for all others, one hundred and seven dollars.

Graduation Fee for the Master's degree is ten dollars.

Board and Rooms. Good board may be obtained for seven to ten dollars per week, and rooms for four to six dollars per week.

FELLOWSHIPS IN HIGHWAY ENGINEERING AND HIGHWAY TRANSPORT

The Roy D. Chapin Fellowship in Highway Transport. This Fellowship is offered to provide for the investigation of an approved subject relative to Highway Transport. It pays the sum of $250 with an allowance of $50 for expenses.

The Roy D. Chapin Fellowship in Highway Engineering. This Fellowship is offered to provide for the investigation of an approved subject relative to hard surfaced roads and pavements. It pays the sum of $250 with an allowance of $50 for expenses.

Two Detroit Edison Company Fellowships in Highway Engineering. These Fellowships are offered for the investigation of approved subjects relative to moderate cost country roads. Each Fellowship pays the sum of $250 with an allowance of $50 for expenses.

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General Conditions: A Fellow must hold a Bachelor's degree from a college of recognized standing. He must enroll as a candidate for the degree of Master of Science or Master of Science in Engineering and be in residence for one of the following periods. First Semester (October to February); Winter Period (December to March); Second Semester (February to June). An application for a Fellowhsip must include a concise statement of the candidate's educational training and his activities since he received the Bachelor's degree. Fellows do not have to pay tuition fees.

HIGHWAY LABORATORY

The highway laboratory is located in the north half of the old stone power house on the Campus. It has 4,800 square feet of laboratory floor space, in addition to which there are rooms used as offices and computing rooms. The laboratory is equipped with the necessary apparatus for the testing of paving brick, stone block, wood block, rock, slag, sand, gravel, sand-clay mixtures, cement, concrete, bituminous materials, and other materials used in the construction and maintenance of highways.

Among the more important pieces of apparatus and equipment are a four-cylinder Deval abrasion machine for abrasion tests on broken stone, two standard brick rattlers, a ball mill and briquette molding machine for conducting cementation tests on rock powder, a Page impact machine, a Dorry hardness machine, two diamond core drills, a 200,000 pound compression testing machine, tensile testing machines for cement, a Per Se sieve shaker, a Ro-Tap seive shaker, a Dulin Rotarex for the extraction of bituminous cements, standard pentrometers, ductility machines, viscosimeters, constant temperature baths, and a Fraes electric oven. A testing machine of

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Fraes and other types of electric ovens, analytical, chainomatic and torsion balances, and field testing apparatus.

LIBRARIES

The Davis Library of Highway Engineering and Highway Transport, located on the first floor of the north wing of the East Engineering Building, is the most complete collection of literature on highway engineering and highway transport in this country. All the most recent books have been purchased and in addition many old volumes, which are of interest from a historic point of view, have been secured. Town, municipal, county, park, state and government reports and specifications, many monographs and complete files of trade publications also form an important part of this Library. All technical periodicals which contain articles relative to highway engineering and highway transport are on file, hence the latest literature on the science and art of these subjects is available. The Library is equipped with eleven comprehensive indexes covering its books, reports, specifications, pamphlets, catalogs of materials and machinery, literature on highway engineering, and literature on highway transport. The Library is open to the public Mondays to Fridays from 8:00 A. M. to 12:00 M. and from 1:30 to 5:00 P. M., and on Saturdays from 8:00 A. M. to 12:00 M.

In addition to the Davis Library, the University Library and the Engineering and Chemical Engineering Libraries may be used by advanced or graduate students in highway engineering and highway transport.

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SCHEDULE OF GRADUATE SHORT PERIOD COURSES

DECEMBER 8 TO 19, 1924

C. E. 77. Highway Engineering Financing, Management and Organization. Professor Swinton.

C. E. 81. American and English Highway Transport Methods. Professor Blanchard.

DECEMBER 22, 1924, TO JANUARY 2, 1925

C. E. 67. Highway Transport Economics and Surveys. Professors Blanchard and Swinton.

C. E. 72. Gravel and Quarry Plants, and Gravel and Broken Stone Roads. Professor Morrison.

JANUARY 5 TO 16, 1925

C. E. 73. Brick, Cement-Concrete, Stone Block and Wood Block Pavements. Professor Morrison.

C. E. 76. Highway Engineering Theory and Design. Professor Swinton.

C. E. 80. Interrelationship of Highway, Railway and Waterway Transport. Professors Riggs and Worley.

JANUARY 19 TO 30, 1925

C. E. 68. Bituminous Surface Treatments; Bituminous Macadam, Bituminous Concrete, and Sheet Asphalt Pavements. Professor Blanchard.

C. E. 84. Highway Transport Management. Professor Swinton.

FEBRUARY 2 TO 13, 1925

C. E. 69. Highway Laboratory Research. Professor Morrison.

C. E. 70. Highway Structures. Professors Gram and Cissel.

M. E. 40. Mechanism, Operation and Maintenance of Motor Trucks, Tractors and Trailers. Professor Lay.

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FEBRUARY 16 TO 19, 1925

Eleventh Annual State Conference on Highway Engineering at the University of Michigan.

FEBRUARY 23 TO MARCH 6, 1925

C. E. 71 Highway Specifications, Contracts and Jurisprudence. Professor Riggs.

C. E. 82. Highway Transport Costs and Record Systems. Professor Swinton.

MARCH 9 TO 20, 1925

C. E. 76. Highway Engineering Theory and Design. Professor Swinton.

C. E. 78. Grading Machinery and Operations, Drainage Systems, and Earth and Sand-Clay Roads. Professor Morrison.

C. E. 79. Highway Transport Legislation. Professor Blanchard.

C. E. 85. Traffic Engineering and Its Applications to Street Design and City Planning. Professor Blanchard.

DECEMBER 8, 1924, TO MARCH 20, 1925

C. E. 75. Highway Engineering Seminar. Professors Blanchard, Morrison and Swinton.

C. E. 83. Highway Transport Seminar. Professors Blanchard and Swinton.

COURSES OF INSTRUCTION

Civil Engineering 67. *Highway Transport Economics and Surveys.* Lectures and library reading. December 22, 1924, to January 2, 1925. Professors Blanchard and Swinton.

This course treats of highway transport economics and surveys from the standpoints of highway transport business and highway improvement. The subjects covered include office and field methods of estimating the

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amount and character of future traffic; investigations of highway routes and commercial highway transport business opportunities; determination of the traffic capacity of roadways, and the relation of grades, curves, widths, and types of roads and pavements to the efficiency and cost of operation of highway transport.

Civil Engineering 68. *Bituminous Surface Treatments; Bituminous Macadam, Bituminous Concrete and Sheet-Asphalt Pavements.* Lectures and library reading. January 19 to 30, 1925. Professor Blanchard.

This course covers bituminous surface treatments, bituminous macadam pavements, bituminous concrete pavements, asphalt block pavements and sheet-asphalt pavements. Each type of construction will be considered from the following standpoints: Economic value; foundations; theory and design; kinds of bituminous and non-bituminous materials used and desirable qualities thereof; methods of construction; types of machinery used and manipulation thereof; inspection methods; nature of wear and deterioration; methods of maintenance; guarantees.

Civil Engineering 69. *Highway Laboratory Research.* Lectures, library reading and laboratory investigations. February 2 to 13, 1925. Professor Morrison.

This course covers advanced problems pertaining to the physical properties of earth, sand-clay mixtures, sand, gravel, broken stone, broken slag, paving brick, cement-concrete, wood blocks and stone blocks; physical and chemical properties of bituminous materials; highway laboratory administration, organization and equipment; sampling and inspection methods; field tests.

Civil Engineering 70. *Highway Structures.* Design problems and library reading. February 2 to 13, 1925. Professors Gram and Cissel.

This course consists of design work along special lines applicable to the needs of each student. The course may

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be devoted to such problems as the following: The design of highway bridges of steel, cement-concrete or reinforced concrete, grade crossing structures, retaining walls, or foundations and pavements as structures. Prerequisite, theory and design of structures. This course is open only to graduate students who receive special permission from Professor Lewis M. Gram.

Civil Engineering 71. Highway Specifications, Contracts and Jurisprudence. Lectures and library reading. February 23 to March 6, 1925. Professor Riggs.

The essential elements of a contract; bids and bidders on public work; the conduct of public lettings; clauses which should be included in properly drawn contracts covering time, liquidated damages, manner of payment, extra work, defective materials or work; custom and usage as affecting engineering contracts; the duties and powers of the engineer; breach of contract; specifications; proper methods of preparing; the engineer as a professional man; contracts for professional services; the engineer in court; witness as to facts; expert witness; jurisprudence relative to surface waters and boundaries.

Civil Engineering 72. Gravel and Quarry Plants, and Gravel and Broken Stone Roads. Lectures, library reading, and laboratory demonstrations. December 22, 1924, to January 2, 1925. Professor Morrison.

Physical properties of gravel and rock; methods of testing in the field and laboratory; interpretation of results of tests; gravel and quarry plants, characteristics of layouts, and operation; characteristics, economic utilization, and fundamentals of construction and maintenance of gravel and broken stone roads.

Civil Engineering 73. Brick, Cement-Concrete, Stone Block and Wood Block Pavements. Lectures and library reading. January 5 to 16, 1925. Professor Morrison.

This course covers the economic utilization and funda-

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mentals of construction and maintenance of brick, cement-concrete, stone block and wood block pavements, and the essential properties and methods of testing of brick. cement-concrete, stone block and wood block.

Civil Engineering 75. *Highway Engineering Seminar.* Library research, and preparation and presentation of addresses, papers and reports. Open only to graduate students. December 8, 1924, to March 20, 1925. Professors Blanchard, Morrison and Swinton.

Assigned work on approved definite problems relating to administration, organization, economics, design, materials, construction and maintenance.

Civil Engineering 76. *Highway Engineering Theory and Design.* Lectures, library reading and design problems. January 5 to 16 and March 9 to 20, 1925. Professor Swinton.

Theory and design of highway systems, location, intersections, widths, cross-sections, curves, and grades; methods of estimating earthwork; car tracks; sidewalks; curbs and gutters; guard rails; field methods of reconnoisance. Prerequisites, Civil Engineering 40, Drawing 1, Engineering Mechanics 1 and Surveying 1 or their equivalents.

Civil Engineering 77. *Highway Engineering Financing, Management and Organizations.* Lectures and library reading. December 8 to 19, 1924. Professor Swinton.

This course treats of financing, management and organizations from the standpoints of highway departments and contractors. Financing will cover long-term, short-term, and serial bonds, annual appropriations, local assessments, expenses to be financed, contractors' financial obligations and methods of payment for work. Management will cover administrative control of office routine, construction, maintenance, street cleaning and snow removal, including use of planning boards, visible records;

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and unit cost records. Organizations will be considered from the viewpoint of national, state, county, township and municipal highway departments, and large and small contracting companies.

Civil Engineering 78. *Grading Machinery and Operations, Drainage Systems, and Earth and Sand-Clay Roads.* Lectures and library reading. March 9 to 20, 1925. Professor Morrison.

Considerations affecting the purchase of grading machinery; fundamentals of different types of grading machines; efficient methods of using grading equipment; clearing and grubbing; economic comparison of methods of making excavations and embankments with different types of machines; grading organizations. Theory and design of drainage systems. Characteristics, economic utilization, and fundamentals of the construction and maintenance of earth and sand-clay roads.

Civil Engineering 79. *Highway Transport Legislation.* Lectures and library reading. March 9 to 20, 1925. Professor Blanchard.

Legislation pertaining to weights, dimensions and speeds of motor trucks, tractors, trailers and motor-busses; licenses and taxes; common carriers; franchises; and rates. Decisions by state commissions and courts.

Civil Engineering 80. *Interrelationship of Highway, Railway and Waterway Transport.* Lectures and library reading. January 5 to 16, 1925. Professors Riggs and Worley.

Development of highway, railway and waterway transportation; economic comparison of methods of transportation of passengers and commodities; characteristics and efficiency of each type of transportation.

Civil Engineering 81. *American and English Highway Transport Methods.* Lectures and library reading. December 8 to 19, 1924. Professor Blanchard.

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Economic comparison of horse and motor transport; municipal haulage; store door delivery; inter-city haulage; long and short haulage outside of cities; rural motor express; plant and factory haulage; motor bus transportation; utilization of highway transport by steam and electric railways; efficient methods of packing, handling, loading and unloading raw and manufactured materials; highway transport clearing houses; port, terminal and warehouse facilities.

Civil Engineering 82. *Highway Transport Costs and Record Systems.* Lectures and library reading. February 23 to March 6, 1925. Professor Swinton.

Elements of cost of operation of motor vehicles; interest charges and depreciation; Truck Owners' Conference cost system and other systems; ton mile costs; drivers', garage and office records; performance, service and maintenance records.

Civil Engineering 83. *Highway Transport Seminar.* Library research, and preparation and presentation of addresses, papers and reports. Open only to graduate students. December 8, 1924, to March 20, 1925. Professors Blanchard and Swinton.

Assigned work on special problems relating to highway transport economics, operation, methods, legislation and management.

Civil Engineering 84. *Highway Transport Management.* Lectures and library reading. January 19 to 30, 1925. Professor Swinton.

Fundamentals of efficient management of the different highway transport methods; administration and organization of transportation companies; planning delivery systems; scheduling and routing; management of office, garage and repair shops; drivers' bonus and commission systems; supervision by mechanical devices.

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Civil Engineering 85. *Traffic Engineering and Its Applications to Street Design and City Planning.* Lectures, library reading, reports and problems. March 9 to 20, 1925. Professor Blanchard.

Traffic engineering; traffic surveys and statistics; traffic capacity of roadways; causes of traffic delays; traffic control and management; traffic regulations; block and rotary systems; signs, signals and other traffic guides; safety zones; commercial garages, lot storage and curb parking; traffic accidents. City and regional planning and street design; transportation systems; terminal facilities; street systems; arterial, business and residence streets; by-pass highways; one-way, segregated and through traffic streets; elevated roadways; intersections; street cross-sections; street, roadway and sidewalk widths; methods of increasing traffic capacity; location of car tracks.

Mechanical Engineering 40. *Mechanism, Operation and Maintenance of Motor Trucks, Tractors, and Trailers.* Lectures, library reading and laboratory demonstrations. February 2 to 13, 1925. Professor Lay.

Engines, including operating cycles, valves and valve timing, carburetion, ignition systems, oiling systems, cooling, rating and characteristic curves; clutches; transmission and drive shafts; rear axles and differentials; front axles and steering mechanism; brakes; springs; engine and truck testing and performance curves; tractors; trailers; truck operation, control and maintenance.

THE UNIVERSITY BULLETIN IS REGULARLY ISSUED BY THE UNIVERSITY OF MICHIGAN ONCE EVERY WEEK.

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UNIVERSITY BULLETIN

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UNIVERSITY OF MICHIGAN.

COLLEGE OF ENGINEERING •
DEPARTMENT OF CIVIL ENGINEERING •
DIVISION OF HIGHWAY ENGINEERING AND HIGHWAY TRANSPORT

Professional Short Period Advanced Courses

in

Highway Engineering

and

Highway Transport

1925-1926

ANN ARBOR
PUBLISHED BY THE UNIVERSITY
1925

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INTRODUCTION

The Board of Regents of the University, by its action in establishing a Chair of Highway Engineering and Highway Transport, by its appointment of an Associate Professor, an Assistant Professor, a Librarian, an Instructor, and assistants in Highway Engineering and by supplying adequate physical equipment, has made provision for a broad development of highway engineering and highway transport undergraduate and graduate instruction and for the investigation of research problems.

The Division of Highway Engineering and Highway Transport occupies 20,000 square feet of working space on the first floor and in the basement of the north wing of the East Engineering Building, which was completed in 1923. The Davis Library of Highway Engineering and Highway Transport, two lecture rooms especially equipped for the professional courses, a design and drafting room, a seminar room, and the staff offices are located on the first floor. Fourteen rooms in the basement are used for the testing and research work of the Highway Laboratory.

Trained and experienced highway engineers are needed to occupy the innumerable positions connected with the administration, design, construction and maintenance of the 2,900,000 miles of rural highways and the thousands of miles of streets in the municipalities of the United States in order that the highways may efficiently serve the argicultural, industrial, commercial, social and military requirements of the Nation.

The phenomenal development of highway transport has created a demand for men having knowledge of and trained in a new technical field. Fundamentally, this branch of engineering deals with the science, art, eco-

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nomics and business of highway transportation of passengers and commodities. During the past two decades the United States has witnessed a rapid growth in the utilization of the motor vehicle as indicated by a registration of 55,000 motor vehicles in 1904 and 17,591,981 in 1924. While in 1910, a motor truck was rarely seen on the American highways, in 1924 not less than 2,131,332 were in use in the United States.

The demand for men trained in highway engineering and highway transport was crystallized at the Washington Conference on Highway Engineering and Highway Transport Education held in 1920. The seventy delegates representing the automotive and tire industries, transportation organizations, the state highway departments, the U. S. Bureau of Public Roads, the War Department, and colleges of engineering unanimously adopted the following conclusions. First, that highway engineering staffs of the Federal and State Departments will require an annual supply of 900 college trained engineers in addition to the highway engineers required by counties, municipalities, contractors and companies manufacturing highway machinery and materials; second, that 4,000 men should be trained in highway transport each year in universities for positions of motor truck fleet managers, sales-engineers, advertisers, business administrators and highway transport engineers; and third, that short period advanced courses efficiently provide opportunities for men occupying or preparing for the positions enumerated to obtain a knowledge of and training in highway engineering and highway transport. Professional Short Period Courses were also endorsed in the 1921 Report of the Committee on "Civil Engineering" of the Society for the Promotion of Engineering Education.

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MEMBERS OF THE FACULTY AND OTHER LECTURERS

Division of Highway Engineering and Highway Transport

Arthur H. Blanchard, C.E., A.M., Professor of Highway Engineering and Highway Transport. Member, American Society of Civil Engineers, American Association of State Highway Officials, Society of Automotive Engineers, Engineering Institute of Canada, Societe des Ingenieurs Civils de France, Permanent International Association of Road Congresses, International Association for Testing Materials, American Society for Municipal Improvements, American Concrete Institute, American Wood Preservers' Association, Michigan Engineering Society, City Planning Conference, Secretary of Commerce Hoover's National Committee on Metropolitan Traffic Facilities, and Advisory Board on Highway Research of the National Research Council. Fellow, American Association for the Advancement of Science. Director, Eno Foundation for Traffic Regulation, Inc. Past-President, American Road Builders' Association. President, National Highway Traffic Association. 1896-1903, with Highway Department, Providence, R. I., American Bridge Company, and R. I. Stone Bridge Commission. 1903-1910, Deputy Chief Engineer, State Board of Public Roads of Rhode Island. 1911-1917, Professor of Highway Engineering, Columbia University. 1910 to date, Consulting Highway Engineer to U. S. Bureau of Public Roads, Dominion of Canada, State Highway Departments of New York and Pennsylvania, National Highways Association, and various

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counties, municipalities, corporations, and contractors. 1921 to date, member, firm of Blanchard and Smith, Highway Transport Consultants. 1923 to date, Consulting Engineer, Michigan State Highway Department. Author, "Elements of Highway Engineering." Editor-in-Chief, "American Highway Engineers' Handbook" and "American Highway Transport Handbook" (in preparation).

Roger L. Morrison, C.E., A.M. (Highway Engineering, Columbia University). Associate Professor of Highway Engineering. Member, American Society of Civil Engineers, American Association of State Highway Officials, American Society for Testing Materials, American Concrete Institute, National Highway Traffic Association, and Permanent International Association of Road Congresses. 1914-1919, Professor of Highway Engineering, A. and M. College of Texas. 1905 to date, professional experience with Southern Pacific and Western Pacific Railroads, Illinois State Highway Department, United Gas Improvement Company, Brazos County, Texas, as Consulting Engineer, Pittsburgh Testing Laboratory as Engineer of Tests in charge of southern states, and Concrete Products Company, as Treasurer and General Manager. Appointed 1924, Director, Michigan State Highway Laboratory.

Roy S. Swinton, M.S.E. (Highway Engineering and Highway Transport, University of Michigan). Assistant Professor teaching Highway Engineering and Highway Transport. Associate Member, American Society of Civil Engineers. Member, National Highway Traffic Association, and Permanent International Association of Road Congresses. 1910-1915, on Faculty of University of Philippines; 1915 to date, engineering practice including valuation of public utilities, and Consultant, Detroit Transportation Association.

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Harriet E. Lambert, Member, National Highway Traffic Association, and Permanent International Association of Road Congresses. 1916-1919, Research Assistant and Compiler of Bibliographies for Editor-in-Chief, "American Highway Engineers' Handbook". 1919 to date, Librarian in Charge, Davis Library of Highway Engineering and Highway Transport, University of Michigan.

Edgar R. Kendall, M.S.E. (Highway Engineering and Highway Transport, University of Michigan). Member, American Society for Testing Materials, American Concrete Institute, Society of American Military Engineers, and Permanent International Association of Road Congresses. 1920-1924, Office Engineer, Michigan State Highway Department. 1924 to date, Lecturer on Highway Materials, University of Michigan, and Assistant Director, Michigan State Highway Laboratory.

Edwin A. Boyd, Member, American Society for Testing Materials, and Permanent International Association of Road Congresses. 1915 to date, Instructor in Highway Laboratory Practice, University of Michigan, and 1919 to date, Laboratory Supervisor, Michigan State Highway Laboratory.

Department of Civil Engineering and Division of Automotive Engineering

Henry E. Riggs, A.B., C.E., Professor of Civil Engineering. Member, American Society of Civil Engineers, American Institute of Consulting Engineers, American Railway Engineering Association, National Highway Traffic Association, Permanent International Association of Road Congresses, American Economic Association, and American Academy of Political and Social Science. 1886-1896, with Burlington, A. T. & S. F. and Ann Arbor & N. Michigan Railways. 1896 to date, consulting and

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valuation engineer to various states, municipalities, railways and public utility corporations. Author, "Depreciation of Public Utility Properties."

Lewis M. Gram, B.S. in C.E. Professor of Structural Engineering. Member, American Society of Civil Engineers and American Concrete Institute. 1901 to date, with American Bridge Company, Massillon Bridge Company, A. Bentley & Sons, and W. G. Clark as structural engineer, and consulting engineer on various structures including the Belle Isle Bridge.

John S. Worley, M.S. Professor of Transportation Engineering. Member, American Society of Civil Engineers and American Railway Engineering Association. 1901 to date, consulting engineer to steam and interurban railways, public utility corporations and Interstate Commerce Commission. 1921 to date, Acting Manager, Habirshaw Electric Cable Company.

James H. Cissel, B.S. in C.E. Associate Professor of Structural Engineering. Member, American Society of Civil Engineers and American Concrete Institute. 1913 to date, engineer with Kansas City Terminal Railway, Santa Fe Coast lines, M. E. Cooley, valuation engineer, and on Belle Isle Bridge, and consulting engineer on various structures for individuals and corporations.

Walter E. Lay, B.M.E. Associate Professor of Automotive Engineering and Director of the Automotive Laboratories. Member, Society of Automotive Engineers. 1912 to date, with Packard Motor Car Company, Chevrolet Motor Company, General Motors Corporation, and U. S. National Committee on Aeronautics.

Resident Lecturers

Henry C. Anderson, B.M.E., Professor of Mechanical Engineering.

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Mortimer E. Cooley, Eng. D., Sc.D., LL.D., Professor of Mechanical Engineering, and Dean of the Colleges of Engineering and Architecture.

Edmund E. Day, Ph.D., Professor of Economics, and Dean of the School of Business Administration.

Arthur J. Decker, B.S., Professor of Sanitary Engineering.

Charles B. Gordy, A.M., Assistant Professor of Mechanical Engineering, and Lecturer on Production Management in School of Business Administration.

Henry H. Higbie, E.E., Professor of Electrical Engineering.

William C. Hoad, B.S., Professor of Municipal and Sanitary Engineering.

William H. Hobbs, Ph.D., Professor of Geology, and Director of the Geological Laboratory and Geological Museum.

Horace W. King, B.S. in C.E., Professor of Hydraulic Engineering.

Edward H. Kraus, Ph.D., Sc.D., Professor of Crystallography and Mineralogy, and Director of the Mineralogical Laboratory; Dean of the College of Pharmacy, and Dean of the Summer Session.

Eugene H. Leslie, Ph.D., Professor of Chemical Engineering.

William A. Paton, Ph.D., Professor of Economics, and Professor of Accounting in School of Business Administration.

Thomas H. Reed, A.B., LL.B., Professor of Political Science, and Director of the Bureau of Government.

Herbert C. Sadler, Sc.D., Professor of Naval Architecture and Marine Engineering.

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Aubrey Tealdi, Graduate, Roy Tech Institute, Livorno, Professor of Landscape Design and Director of the Arboretum.

Albert E. White, A.B., Sc.D., Professor of Metallurgical Engineering, and Director of the Department of Engineering Research.

Alfred H. White, A.B., B.S., Professor of Chemical Engineering.

Leigh J. Young, A.B., M.S.F., Associate Professor of Forestry.

Non-Resident Lecturers

Duff A. Abrams, Professor in Charge of the Structural Materials Research Laboratory, Lewis Institute.

Clarence E. Bardsley, Assistant Professor of Civil Engineering, School of Mines, University of Missouri, and National Slag Association Fellow in Highway Engineering, University of Michigan.

C. F. Boehler, Road Engineer, Michigan State Highway Department.

H. L. Brightman, Engineer of Surveys and Plans, Michigan State Highway Department.

V. R. Burton, Engineer on Special Assignments, Michigan State Highway Department.

Roy D. Chapin, Chairman, Board of Directors, Hudson Motor Car Company.

Frank W. Cherrington, Director, Engineering and Sales, Jennison-Wright Company.

G. C. Dillman, Deputy Commission-Chief Engineer, Michigan State Highway Department.

Alex Dow, President, Detroit Edison Company.

Edward Duff, Jr., Secretary, National Paving Brick Manufacturers' Association.

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Frank D. Fitzgerald, Business Manager, Michigan State Highway Department.

Charles N. Forest, Manager, Technical Department, The Barber Asphalt Company.

Arthur R. Hirst, Chief Engineer, The American Vibrolithic Corporation.

Frederick Hubbard, Research Engineer, Standard Slag Company.

Prevost Hubbard, Chemical Engineer, The Asphalt Association.

G. C. Kelcey, Manager, Traffic Engineering Division, American Gas Accumulator Company.

W. H. Kershaw, Manager, Asphalt Department, The Texas Company.

Edward F. Loomis, Secretary, National Motor Truck Committee, National Automobile Chamber of Commerce.

Alfred F. Masury, Vice-President and Chief Engineer, International Motor Company.

C. A. Melick, Bridge Engineer, Michigan State Highway Department.

Frank D. Messenger, Engineer of Materials and Equipment, Michigan State Highway Department.

Carl Parker, Manager of Sales, Bus and Taxicab Department, Reo Motor Car Company.

G. H. Perkins, Vice-President, Warren Brothers Company.

Clarence D. Pollock, Consulting Paving Engineer, New York City.

George H. Pride, Highway Transport Engineer, Autocar Company.

E. O. Rhodes, Chemical Director, American Tar Products Company.

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Frank F. Rogers, State Highway Commissioner of Michigan.

Francis P. Smith, Chemical and Consulting Highway Engineer, New York City.

R. A. Smith, State Geologist of Michigan.

B. C. Tiney, Maintenance Engineer, Michigan State Highway Department.

T. C. Walden, District Manager, Motor Bus Department, Mack Trucks, Inc., International Motor Company.

Col. Sidney D. Waldon, Chairman, Rapid Transit Commission of Detroit.

Col. Joseph H. Wasson, Field Engineer, Portland Cement Association.

L. E. Williams, Manager, Sand and Gravel Plants, United Fuel and Supply Company.

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PROFESSIONAL SHORT PERIOD ADVANCED COURSES

General Statement

During the winter of 1925-1926, the University of Michigan will offer twenty-one professional short period advanced courses in Highway Engineering and Highway Transport especially designed for mature men in practice or preparing for positions in the fields of Highway Engineering or Highway Transport or with companies manufacturing machinery or materials used in Highway Engineering, or motor trucks, trailers or motor coaches. Seventeen of these courses are open to any person over twenty-one years of age, that is, persons of mature age, who do not hold collegiate or technical degrees may register as special students, not candidates for a degree.

These courses will be given *in periods of two weeks each* during the months from December to March inclusive. Each course consists of thirty lectures, or the equivalent thereof, and counts as two hours credit towards the total of twenty-four hours required for the degree of Master of Science or Master of Science in Engineering. These courses also may be taken for credit as the subject of primary interest by candidates for the degree of Doctor of Philosophy or Doctor of Science. The University requires that each candidate for a Master's degree shall be in residence for one collegiate year or eight months. Candidates for the Master's degree, who are taking graduate courses in highway engineering or highway transport, may fulfill the residence requirement in one of three ways: First by being in residence for one collegiate year; second, by being in residence for two winter periods from December to March, inclusive; and third, by the distribution of residence over several years

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by being in attendance for parts of three or more winter periods. The University further requires that each candidate for a higher degree must hold a baccalaureate or an engineering degree from an approved institution.

The above plan, which has the support of many of the foremost highway officials and engineers, and highway transport experts in the United States, will afford highway engineers, chemists, contractors, engineer-salesmen, highway transport engineers and managers, motor truck salesmen, steam and electric railroad traffic managers, and others interested in highway engineering and highway transport an opportunity to obtain advanced knowledge during the season of the year when a leave of absence may be easily obtained.

The professional short period advanced courses are conducted in a manner similar to the meeting of a session of a convention, namely, the professor in charge lectures while the members of the class take part in discussions. In one year thirty-eight states and fourteen foreign countries were represented by those in attendance. The wide range of discussion resulting is self-evident. During one winter, 110 men attended these courses, the average age of the men being 27 years, ranging from 23 to 56. These men came from the U. S. Bureau of Public Roads, U. S. Army Transport Corps, state, county and municipal highway departments, contractor's organizations, companies manufacturing motor trucks, highway machinery and materials, universities, and from the field of highway transport.

As indicative of the types of men who take the professional courses, the following positions held at the time of enrollment are mentioned: Associate Highway Bridge Engineer, U. S. Bureau of Public Roads; Assistant Engineer, Illinois Highway Department; Senior Inspector, Pennsylvania Highway Department; Construction Engineer, Milton Hersey Company, Ltd., Montreal; District

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Engineer, U. S. Bureau of Public Roads; District Engineer, Bureau of Public Works, Philippine Islands; Engineer, Highway Department, Tokyo, Japan; Project Engineer, Indiana State Highway Department; Major, Quartermaster's Corps, U. S. Army; Assistant Professor of Civil Engineering, Washington University; Chief Engineer, Department of Highways, Canton, China; Transport Engineer, Duplex Motor Truck Company; District Engineer, Pennsylvania State Highway Department; Highway Contractor, Lorain, Ohio; Chemical Engineer, American Tar Products Company; Engineer-Salesman, Hetherington and Berner Company; Division Engineer, Department of Public Works, Porto Rico; Testing Engineer, Colorado State Highway Department; Branch Manager, Service Motor Truck Company; District Engineer, Michigan State Highway Department; Highway Transport Engineer, Goodyear Tire and Rubber Company; Engineer, Packard Motor Car Company; Branch Manager, Reo Motor Car Company; Superintendent of Quarries, Alabama Rock Asphalt Company; Assistant Engineer, Maryland State Roads Commission; Assistant Engineer, Ohio State Highway Department; Assistant Foreman, Highway Construction Company, Elyria, Ohio; District Highway Engineer, City of Mexico; Professor of Highway Engineering, Kwangtung College, China; Salesman, Barrett Manufacturing Company; District Engineer, Georgia State Highway Department; Resident Engineer, South Dakota State Highway Department; Highway Engineer, Varnamo, Sweden; Engineer, La Paz, Bolivia, South America.

For further information pertaining to graduate and professional courses, and semester and summer session courses in highway engineering and highway transport, write to Arthur H. Blanchard, Professor of Highway Engineering and Highway Transport, 1026 East Engineering Building, University of Michigan, Ann Arbor, Michigan.

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ADMISSION AND REGISTRATION

Every student, who expects to be an applicant for admission to the Graduate School as a candidate for a Master's or a Doctor's degree should obtain a copy of the Announcement of the Graduate School, which gives full information concerning the conditions under which the advanced degrees are conferred. Requests for Announcements should be addressed to Dr. Alfred Lloyd, Dean of the Graduate School.

All persons who wish to enroll in the Professional Short Period Advanced Courses should report, upon arrival at the University, at the office of the Professor of Highway Engineering and Highway Transport on the first floor of the East Engineering Building. After the schedule of courses has been arranged, a student, who has received a baccalaureate or professional degree, will register at the office of the Graduate School, Room 1014, Angell Hall, while a student, who does not hold a degree, will register in the Davis Library, 1024 East Engineering Building, as a special student in the College of Engineering.

FEES AND EXPENSES

Professional Short Period Advanced Courses. The fee for each of the Professional Short Period Courses in Highway Engineering and Highway Transport, Civil Engineering 67 to 86, and Mechanical Engineering 40, is ten dollars. Students in residence only during the winter period, December to March, and who are taking only the professional short period advanced courses do not have to pay a matriculation fee.

Semester Courses in the Graduate School. Matriculation fee, for Michigan students, ten dollars; for all

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others, twenty-five dollars. Annual fee, for Michigan students, eighty-five dollars; for all others, one hundred and ten dollars.

Graduation Fee for the Master's or Doctor's degree is ten dollars.

Board and Rooms. Good board may be obtained for six to seven dollars per week, and rooms for three to six dollars per week.

FELLOWSHIPS IN HIGHWAY ENGINEERING AND HIGHWAY TRANSPORT

Two Detroit Edison Company Fellowships in Highway Engineering. These Fellowships are offered for the investigation of approved subjects relative to moderate cost country roads.

The Mack Trucks, Inc., Fellowship in Highway Transport. This Fellowship is offered to provide for the investigation of an approved subject relative to Highway Transport.

The National Slag Association Fellowship in Highway Engineering. This Fellowship is offered to provide for the investigation of the utilization of blast furnace slag in the construction and maintenance of roads and pavements.

The Reo Motor Car Company Fellowship in Highway Transport. This Fellowship is offered to provide for the investigation of the economic utilization and operation of motor busses.

The Roy D. Chapin Fellowship in Highway Transport. This Fellowship is offered to provide for the investigation of an approved subject relative to Highway Transport.

The Roy D. Chapin Fellowship in Highway Engineering. This Fellowship is offered to provide for the investi-

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gation of an approved subject relative to hard surfaced roads and pavements.

The United Fuel and Supply Company Fellowship in Highway Engineering. This Fellowship is offered to provide for the investigation of efficient methods of sampling gravel.

General Conditions: Each Fellowship pays the sum of $250 with an allowance of $50 for expenses. Fellows do not have to pay tuition fees, thus increasing the value of a Fellowship by not less than $80. A Fellow must hold a Bachelor's Degree from a college of recognized standing. He must enroll as a graduate student in Highway Engineering or Highway Transport and as a candidate for the degree of Master of Science, Master of Science in Engineering, Doctor of Philosophy, or Doctor of Science. He must be in residence for one of the following periods: First Semester (October to February); Winter Period (December to March); Second Semester (February to June). An application for a Fellowship must include a concise statement of the candidate's educational training and engineering experience and three references, and must be accompanied by a photograph of the applicant. Applications for Fellowships should be sent to Professor Arthur H. Blanchard, 1026 East Engineering Building, University of Michigan, Ann Arbor, Michigan.

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HIGHWAY LABORATORY

The Highway Laboratory, which has 11,000 square feet of floor space, is located in the basement of the north wing of the East Engineering Building. There are special laboratories for the testing of the following materials: Cement; concrete; sand, gravel, broken stone and similar materials; rock and paving brick; asphalt cements, tars and oils; bituminous mixtures; calcium chloride, metals and paints; and culvert pipe. The Laboratory also contains rooms for equipment, balances, concrete curing, storage samples, lockers and showers.

The Laboratory is equipped with all the necessary apparatus for the testing of all kinds of non-bituminous and bituminous materials. Among the more important pieces of apparatus and equipment are a four-cylinder Deval abrasion machine, standard brick rattlers, a Talbot-Jones concrete rattler, ball mills, a briquette molding machine, Page impact machines, a Dorry hardness machine, diamond core drills, a 200,000-pound compression testing machine, tensile testing machines, a binocular microscope, a petrographical microscope, apparatus for testing cement, moist closets, Per Se and Ro-Tap sieve shakers, Dulin Rotarex extraction machines, standard penetrometers, ductility machines, viscosimeters, constant temperature baths, Fraes and other types of electric ovens, analytical, chainomatic and torsion balances, and field testing apparatus.

LECTURE EQUIPMENT

The Division of Highway Engineering and Highway Transport has a complete equipment for use in connection with lectures including two projection machines, seven thousand lantern slides, a moving picture machine,

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models, machines and apparatus used in highway engineering and highway transport, and complete sets of samples of soils and all kinds of highway materials. For illustrative purposes in connection with the courses in highway engineering and highway transport management, the Division uses the following equipment: Dictograph system of interior telephones; Bell system of interdepartment telephones; planning boards; current status visible records; maps with pins and route cords; mechanical bar charts; visible recapitulation charts; mechanical adding machines; Davis Library original filing systems and indexes.

LIBRARIES

The Davis Library of Highway Engineering and Highway Transport, named after its founder, Charles Henry Davis, President of the National Highways Association, is the most complete collection of literature on highway engineering and highway transport in the world. It occupies a spacious room, with storage and coat rooms adjoining, in the northwest corner of the first floor of the East Engineering Building and has a seating capacity for one hundred readers. All the most recent books have been purchased and in addition many old volumes, which are of interest from a historic point of view, have been secured. Town, municipal, county, park, state and government reports and specifications, many monographs and complete files of trade publications also form an important part of this Library. All technical periodicals which contain articles relative to highway engineering and highway transport are on file, hence the latest literature on the science and art of these subjects is available. The Library is equipped with eleven comprehensive indexes covering its books, reports, specifications, pamphlets, catalogs of materials and machinery, literature on highway engineering, and literature on highway

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transport. The Library is open to the public Mondays to Fridays from 8:00 A. M. to 12:00 M. and from 1:30 to 5:00 P. M., and on Saturdays from 8:00 A. M. to 12:00 M.

In addition to the Davis Library, the University Library and the Engineering and Chemical Engineering Libraries may be used by advanced or graduate students in highway engineering and highway transport.

HIGHWAY ENGINEERING AND HIGHWAY TRANSPORT RESEARCH CLUB

The Highway Engineering and Highway Transport Research Club of the University of Michigan is an organization of present and former professional students, members of the Division staff, resident and non-resident lecturers, and Honorary Members. Membership in the Club is voluntary and is regulated by the Constitution of the Club.

The primary purpose of the Club is to promote research in Highway Engineering and Highway Transport through the medium of weekly meetings during the Winter Period at which experts of national reputation deliver addresses on the latest developments in their special fields.

The Club annually publishes a Year Book containing the names, positions, and addresses of all resident and non-resident Members and Honorary Members. The Year Book is widely distributed to state, county and municipal highway departments, highway contractors, companies manufacturing highway machinery and materials, highway transport companies, steam and electric railroad traffic departments, and manufacturers of motor trucks, trailers and motor coaches.

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SCHEDULE OF PROFESSIONAL SHORT PERIOD ADVANCED COURSES

December 7 to 18, 1925

C. E. 77. Highway Engineering Financing, Management and Organization. Professor Swinton.

C. E. 81. American and English Highway Transport Methods. Professor Blanchard.

December 21, 1925, to January 1, 1926

C. E. 67. Highway Transport Economics and Surveys. Professors Blanchard and Swinton.

C. E. 72. Gravel and Quarry Plants, and Gravel and Broken Stone Roads. Professor Morrison.

January 4 to 15, 1926

C. E. 68. Bituminous Surface Treatments; Bituminous Macadam, Bituminous Concrete, and Sheet Asphalt Pavements. Professor Blanchard.

C. E. 80. Interrelationship of Highway, Railway and Waterway Transport. Professors Riggs and Worley.

C. E. 86. Public Utility Problems. Professor Riggs.

January 18 to 29, 1926

C. E. 73. Brick, Cement-Concrete, Stone Block and Wood Block Pavements. Professor Morrison.

C. E. 76. Highway Engineering Theory and Design. Professor Swinton.

C. E. 84. Highway Transport Management. Professor Swinton.

February 1 to 12, 1926

C. E. 69. Highway Laboratory Research. Professor Morrison.

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C. E. 70. Highway Structures. Professors Gram and Cissel.

M. E. 40. Mechanism, Operation and Maintenance of Motor Trucks, Tractors and Trailers. Professor Lay.

FEBRUARY 15 TO 18, 1926

Twelfth Annual State Conference on Highway Engineering at the University of Michigan.

FEBRUARY 22 TO MARCH 5, 1926

C. E. 71. Highway Specifications, Contracts and Jurisprudence. Professor Riggs.

C. E. 82. Highway Transport Costs and Record Systems. Professor Swinton.

MARCH 8 TO 19, 1925

C. E. 76. Highway Engineering Theory and Design. Professor Swinton.

C. E. 78. Grading Machinery and Operations, Drainage Systems, and Earth and Sand-Clay Roads. Professor Morrison.

C. E. 79. Highway Transport Legislation. Professor Blanchard.

C. E. 85. Traffic Engineering and Its Applications to Street Design and City Planning. Professor Blanchard.

DECEMBER 7, 1925, TO MARCH 19, 1926

C. E. 74. Bituminous Materials. Professor Morrison.

C. E. 75. Highway Engineering Seminar. Professors Blanchard, Morrison and Swinton.

C. E. 83. Highway Transport Seminar. Professors Blanchard, Morrison and Swinton.

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DESCRIPTION OF COURSES

Civil Engineering 67. *Highway Transport Economics and Surveys.* Lectures and library reading. December 21, 1925, to January 1, 1926. Professors Blanchard and Swinton.

This course treats of highway transport economics and surveys from the standpoints of highway transport business and highway improvement. The subjects covered include office and field methods of estimating the amount and character of future traffic; investigations of highway routes and commercial highway transport business opportunities; determination of the economic traffic capacity and time losses occurring on roadways under varying percentages of the several types of traffic; methods of observation for necessary data and evaluation of extra costs of highway transport arising from grades, curves, widths, types of roadway surface and obstructions to visibility; a study of the capacity of trucks and tractors to haul trailers over known routes.

Civil Engineering 68. *Bituminous Surface Treatments; Bituminous Macadam, Bituminous Concrete and Sheet-Asphalt Pavements.* Lectures and library reading. January 4 to 15, 1926. Professor Blanchard.

This course covers bituminous surface treatments, bituminous macadam pavements, bituminous concrete pavements, asphalt block pavements and sheet-asphalt pavements. Each type of construction will be considered from the following standpoints: Economic value; foundations; theory and design; kinds of bituminous and non-bituminous materials used and desirable qualities thereof; methods of construction; types of machinery used and manipulation thereof; inspection methods; nature of wear and deterioration; methods of maintenance; guarantees.

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Civil Engineering 69. *Highway Laboratory Research.* Lectures, library reading and laboratory investigations. February 1 to 12, 1926. Professor Morrison.

The primary objects of this course are to show how to specify the best material for any given purpose, and how to insure the furnishing of the materials as specified. Manufacturing processes are considered, and the relation of the properties of the various materials to their performance in service. Inspections of materials at the producing plants, in the field and in the laboratory are studied and special attention is paid to the interpretation of the results of tests. The laboratory work includes tests of earth, sand-clay mixtures, sand, gravel, broken stone, broken slag, paving brick, cement, concrete, wood blocks, stone blocks, and bituminous materials, and assigned research problems.

Civil Engineering 70. *Highway Structures.* Design problems and library reading. February 1 to 12, 1926. Professors Gram and Cissel.

This course consists of design work along special lines applicable to the needs of each student. The course may be devoted to such problems as the following: The design of highway bridges of steel, cement-concrete or reinforced concrete, grade crossing structures, retaining walls, or foundations and pavements as structures. Prerequisite, theory and design of structures. This course is open only to graduate students who receive special permission from Professor Lewis M. Gram.

Civil Engineering 71. *Highway Specifications, Contracts and Jurisprudence.* Lectures and library reading. February 24 to March 5, 1926. Professor Riggs.

The essential elements of a contract; bids and bidders on public work; the conduct of public lettings; clauses which should be included in properly drawn contracts covering time, liquidated damages, manner of payment,

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extra work, defective materials or work; custom and usage as affecting engineering contracts; the duties and powers of the engineer; breach of contract; specifications; proper methods of preparing; the engineer as a professional man; contracts for professional services; the engineer in court; witness as to facts; expert witness; jurisprudence relative to surface waters and boundaries.

Civil Engineering 72. Gravel and Quarry Plants, and Gravel and Broken Stone Roads. Lectures, library reading, and laboratory demonstrations. December 21, 1925, to January 1, 1926. Professor Morrison.

The formation and characteristics of gravel and rock deposits, methods of locating and measuring deposits, and the determination of the quality of the materials are studied, as well as the design and operation of gravel plants and rock quarries. Gravel and broken stone roads are discussed from the standpoints of their characteristics; suitability under varying conditions such as traffic, climate and geographical location; elements affecting cost; and proper methods of design, construction and maintenance, including dust prevention by the use of light oils, light tars, calcium chloride and other materials.

Civil Engineering 73. Brick, Cement-Concrete, Stone Block and Wood Block Pavements. Lectures and library reading. January 18 to 29, 1926. Professor Morrison.

This course covers the economic utilization and fundamentals of construction and maintenance of brick, cement-concrete, stone block and wood block pavements, and the essential properties and methods of testing of brick, cement-concrete, stone block and wood block. Methods of manufacturing the materials, various types of construction and maintenance equipment, construction and maintenance methods, handling materials on the work, and field inspection methods are included.

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Civil Engineering 74. *Bituminous Materials.* Lectures, library reading and laboratory investigations. This course may be taken in any two week period between December 7, 1925, and February 12, 1926, and February 22 and March 19, 1926. Professor Morrison.

Includes a study of the hydrocarbons found in bitumens; classification of bituminous highway materials according to types, source and use; laboratory tests of petroleum, native and oil asphalts, rock asphalts, crude and refined tars, and creosoting oils; analysis of bituminous paving mixtures; interpretation of results of tests; factors governing specifications for bituminous materials; purchase, transportation, storage and inspection of bituminous materials. The relation between the properties of the different materials, as produced or specified, and their behaviour in service under various conditions, is studied.

Civil Engineering 75. *Highway Engineering Seminar.* Library research, and preparation and presentation of addresses, papers and reports. Open only to graduate students. December 7, 1925, to March 19, 1926. Professors Blanchard, Morrison and Swinton.

Rigid training in public speaking and argumentation for highway engineers, based on texts in advanced English, logic and public speaking. Assigned work on approved definite problems relating to administration, organization, economics, design, materials, construction and maintenance in the field of highway engineering.

Civil Engineering 76. *Highway Engineering Theory and Design.* Lectures, library reading and design problems. January 18 to 29, and March 8 to 19, 1926. Professor Swinton.

Theory and design of highway systems, location, intersections, widths, cross-sections, simple and superelevated curves and grades; methods of estimating earthwork; car tracks; sidewalks; curbs and gutters; guard-

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rails; field methods of reconnoisance. The design portion of this course is flexible and may be adapted to the needs of professional students whose experience or interest directs them into the study of special features of highway design. Prerequisites, Civil Engineering 40, Drawing 1, Engineering Mechanics 1, and Surveying 1 or their equivalents.

Civil Engineering 77. Highway Engineering Financing, Management and Organizations. Lectures and library reading. December 7 to 18, 1925. Professor Swinton.

This course treats of financing, management and organization from the standpoints of highway departments and contractors. Financing will cover long term, short term, and serial bonds; annual appropriations; local assessments; Federal, state and county aid; gasoline and motor vehicle taxation as sources of highway improvement funds. The contractors relation to the banker, bonding company, contracting parties, financial obligations and methods of payment for work; preparation of quantity estimates, classifications and building unit prices. Management will cover administrative control of office routine, surveys, design, letting of contracts, construction, inspection, maintenance, and street cleaning, including the use of planning boards, current status and visible records, equipment, stockroom and unit cost records applied to the several types of work and plant operated. Organization will be considered from the viewpoint of national, state, county, township and municipal highway departments, and large and small contracting companies.

Civil Engineering 78. Grading Machinery and Operations, Drainage Systems, and Earth and Sand-Clay Roads. Lectures and library reading. March 8 to 19, 1926. Professor Morrison.

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Considerations affecting the purchase of grading machinery; fundamentals of different types of grading machines; efficient methods of using grading equipment; clearing and grubbing; economic comparison of methods of making excavations and embankments with different types of machines; grading organizations. Theory and design of drainage ditches, sub-drains and culverts, including equipment and materials used in their construction and maintenance. Characteristics, economic utilization, and fundamentals of the construction and maintenance of earth and sand-clay roads. A study is made of the various sand-clay mixtures, including field and laboratory tests to determine their suitability under varying conditions of traffic and climate.

Civil Engineering 79. *Highway Transport Legislation.* Lectures and library reading. March 8 to 19, 1926. Professor Blanchard.

American and English legislation pertaining to weights, dimensions and speeds of motor trucks, tractors, trailers and motor-busses; urban, intrastate and interstate common carriers; franchises; rates; national, state, county, township, and municipal licenses and taxes. Decisions by state commissions and courts.

Civil Engineering 80. *Interrelationship of Highway, Railway and Waterway Transport.* Lectures and library reading. January 4 to 15, 1926. Professors Riggs and Worley.

Development of highway, railway and waterway transportation; economic comparison of methods of transportation of passengers and commodities; characteristics and efficiency of each type of transportation; influencing factors of distances, haulage, rates, kinds of freight, packing, equipment, and port, terminal, and warehouse facilities.

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Civil Engineering 81. *American and English Highway Transport Methods.* Lectures and library reading. December 7 to 18, 1925. Professor Blanchard.

Economic comparison of horse and motor transport; municipal haulage; store door delivery; inter-city haulage; long and short haulage outside of cities; rural motor express; plant and factory haulage; motor bus transportation; utilization of highway transport by steam and electric railways; efficient methods of packing, handling, loading and unloading raw and manufactured materials; highway transport clearing houses; port, terminal and warehouse facilities.

Civil Engineering 82. *Highway Transport Costs and Record Systems.* Lectures and library reading. February 24 to March 5, 1926. Professor Swinton.

Elements of cost of operation of motor vehicles, including taxes, interest, depreciation, obsolescence, license fees, insurance, garage, repairs, overhaul, body upkeep, gasoline and oil, tires, driver, lost time, and supervision; Truck Owner's Conference cost system and other systems; cost analysis in units applicable to the type of transportation; comparisons of costs and cost accounting systems; correlation with the usual book keeping systems; accounting record forms and their use by garage, stockroom, driver and office in billing and assembling cost data; estimating costs.

Civil Engineering 83. *Highway Transport Seminar.* Library research, and preparation and presentation of addresses, papers and reports. Open only to graduate students. December 7, 1925 to March 19, 1926. Professors Blanchard, Morrison and Swinton.

Rigid training in public speaking and argumentation for men engaged in highway transport or connected with the motor vehicle industry, based on texts in advanced

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English, logic and public speaking. Assigned work on special problems relating to highway transport economics, operation, methods, legislation and management.

Civil Engineering 84. *Highway Transport Management.* Lectures and library reading. January 18 to 29, 1926. Professor Swinton.

Fundamentals of efficient management and their application to different highway transport methods; administration, organization, and selection of plant and equipment for transportation companies; planning of delivery systems; scheduling, routing, loading, checking and accounting; management of office, garage, and repair shops; advertising and solicitation of business; personnel problems; education of driver; bonus and commission systems; supervision by mechanical devices and posting of records and charts of performance; analysis of the methods used by successful operators of the several types of highway transport.

Civil Engineering 85. *Traffic Engineering and Its Applications to Street Design and City Planning.* Lectures, library reading, reports and problems. March 8 to 19, 1926. Professor Blanchard.

Traffic engineering; traffic surveys and statistics; traffic capacity of roadways; causes of traffic delays; traffic control and management; traffic regulations; block and rotary systems; signs, signals and other traffic guides; safety zones; commercial garages, lot storage and curb parking; traffic accidents. City and regional planning and street design; transportation systems; terminal facilities; street systems; arterial, business and residence streets; by-pass highways; one-way, segregated and through traffic streets; elevated roadways; intersections; street cross-sections; street, roadway and sidewalk widths; methods of increasing traffic capacity; location of car tracks.

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Civil Engineering 86. *Public Utility Problms.* Lectures and library reading. January 4 to 15, 1926. Professor Riggs.

The relations of public utility corporations to the public served by them. Modern problems which have grown out of the failure to understand these relations. The reason for making valuations; theories of value; original cost; cost of reproduction; depreciation; going value and other intangible values. Estimating methods to be adopted under differing conditions. The analysis of estimates. Reasons for variation of estimates in different localities. Overhead items of engineering expense, legal expense and interest. Part of the work of this course will be in the analysis of unit prices to give the student a clear conception of the items that must be taken into account in estimating for various purposes.

Mechanical Engineering 40. *Mechanism, Operation and Maintenance of Motor Trucks, Tractors, and Trailers.* Lectures, library reading and laboratory demonstrations. February 1 to 12, 1926. Professor Lay.

Engines, including operating cycles, valves and valve timing, carburetion, ignition systems, oiling systems, cooling, rating and characteristic curves; clutches; transmission and drive shafts; rear axles and differentials; front axles and steering mechanism; brakes; springs; engine and truck testing and performance curves; tractors; trailers; truck operation, control and maintenance.

ANNUAL HIGHWAY ENGINEERING CONFERENCE

Each year in the month of February, the Division of Highway Engineering and Highway Transport, in cooperation with the Michigan State Highway Department and the Michigan Association of Road Commissioners

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and Engineers, conducts at the University a four-day convention during which addresses are delivered by speakers of national reputation. The purpose of the Conference is to aid in supplying to Road Commissioners and Highway Engineers information relating to the administration and organization of highway departments, regulation of highway transport and traffic, designing and financing of highway improvements, drainage systems and foundations, tests and specifications for highway materials, and the construction and maintenance of roadways and bridges, with special reference to local conditions throughout the State of Michigan. The Twelfth Annual Conference will be held during the period, February 15 to 18, 1926.

THE UNIVERSITY BULLETIN IS REGULARLY ISSUED BY THE UNIVERSITY OF MICHIGAN ONCE EVERY WEEK.

ENTERED AS SECOND-CLASS MATTER AT THE POSTOFFICE AT ANN ARBOR, MICHIGAN.

THE BULLETIN INCLUDES THE FOLLOWING PUBLICATIONS:—

The Annual Report of the President.

The Catalogue of the University.

The Annual Announcements of the College of Literature, Science, and the Arts, the Colleges of Engineering and Architecture, the Medical School, the Law School, the College of Pharmacy, the College of Dental Surgery, the School of Education, the School of Business Administration, the Graduate School, the Summer Session, and the University Extension Division.

Other Announcements of the several departments of instruction, Reports and Communications of University officers, etc.

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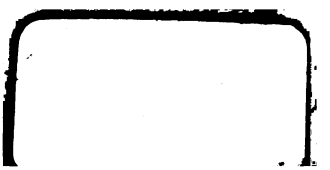

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